

EXECUTIVE SUMMARY



Tri-State Hurricane Property Loss Study

JULY 1989

Alabama • Florida • Mississippi

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Tri-State Hurricane Property Loss and Contingency Planning Study Phase I Alabama, Florida and Mississippi

INTRODUCTION

The Tri-State Hurricane Property Loss and Contingency Planning Study, Phase I, was conducted through cooperative agreements between and funding provided by the Federal Emergency Management Agency, National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers. The states of Alabama, Florida and Mississippi provided in-kind services and coordination in support of the study. This report presents the results of Phase I of a two-phase program designed to quantify the potential effects of hurricanes and associated property damages from such storms along the central gulf coast.

STUDY OBJECTIVE

The objective of the Tri-State Hurricane Property Loss and Contingency Planning Study, Phase I, is to quantitatively estimate the property damages that could occur from potential hurricanes striking the most vulnerable areas of the central gulf coast. Quantitative property loss estimates are necessary to form the basis for hurricane recovery plans prepared at the state and local levels. To plan for recovery or to determine potential future mitigation measures against potential losses from hurricanes, governmental agencies must first have an awareness of the potential locations and magnitudes of hurricane hazards. This phase of study identifies the locations within each county that are highly vulnerable to the destructive forces of hurricanes and provides quantitative estimates of potential damages within those locations. The results of this phase of study is to provide a means to determine the location(s) and extent of the geographic area of study to be performed under Phase II.

LOCATION

The Tri-State Hurricane Property Loss and Contingency Planning Study encompasses approximately 150 miles of open coastline and over 1,000 miles of bay/estuary shoreline in the central Gulf of Mexico and incorporates three states and ten counties into the study area. For this Phase I of study, the study area incorporates the coastal counties of Alabama and Mississippi only. The State of Florida recently completed Phase

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I of a property loss study for the five northwest Florida coastal counties. Those counties will be included in Phase II of this study. The Phase I study area counties included Hancock, Harrison and Jackson Counties in Mississippi, and Mobile and Baldwin Counties in Alabama.

PHYSICAL CHARACTERISTICS

The entire southern boundaries of the study area counties are comprised of a distinctive low level strip of coastal lowlands. This strip of land, averaging five miles wide, ranges in elevation from sea-level to generally 30 feet above sea level. Isolated areas in excess of 50 feet above sea level also exist. The significance of this topographic region is that the majority of the development within each county is located within this strip.

The characteristics of the coastline vary dramatically to the east and west of Mobile Bay. To the west, the Mississippi coastline and the coastline of Mobile County, Alabama are characterized by areas of tidal marsh with very few natural sand beaches, except those that exist on the barrier islands. Beginning in Baldwin County, Alabama, the coastline consists of broad, well developed beaches that extend eastward throughout the remainder of the study area. There are several major and minor bays within the study area that invite development. Along the Mississippi coastline the major bays are St. Louis Bay and Biloxi Bay. Mobile Bay, the largest of the bays, and Perdido Bay are situated along the Alabama coastline.

Dauphin Island, beginning in the western periphery of Mobile Bay, is the easternmost of a chain of offshore barrier islands which form the southern boundary of Mississippi Sound and is the only barrier island containing development. Other barrier islands west of Mobile Bay include Petit Bois, Horn, Ship and Cat Islands.

POPULATION AND DEVELOPMENT

The permanent resident population of the Mississippi and Alabama coastal counties, totaling 750,000 persons in 1980, has increased at a significant rate over the past twenty years. While the population of the United States has increased by 25% since 1960, the population of the central gulf coast has increased by 41%, based upon the 1980 U.S. Census. Accompanying this population increase has been phenomenal structural development along the coastline, especially in Baldwin County, Alabama. This development has occurred at or near the coastline and bay shorelines within each county and consists of single-family, multi-family, and tourist development. Additionally, water dependent industries have also increased within the area.

HISTORIC HURRICANE ACTIVITY

The central Gulf of Mexico is one of the more hurricane vulnerable locations along the coastline of the United States. Official National Weather Service records of tropical cyclone occurrences for the central gulf coast have been compiled dating back to 1872. Since that time, 84 tropical cyclones of at least tropical storm intensity (sustained windspeed greater than 34 knots or approximately 40 miles per hour) have directly affected the Tri-State study area. Of that number, 42 are known to have reached hurricane intensity. For the period 1872-1885, insufficient data exist to accurately determine which of the 13 tropical cyclones that occurred may have reached hurricane intensity. Therefore, for the period of record, 42 hurricane occurrences for the central gulf coast is perhaps a conservative estimate. It is interesting to note that, from the official records, the longest span of consecutive years without a hurricane affecting the study area has been six, 1918-1923, inclusive.

GENERAL STUDY METHODOLOGY

The major tasks performed for the study included property and development inventories; property valuations; development of hurricane surge and wind data; development of loss zones within each county; and calculations of potential property damages.

The property inventories and valuations were conducted by contract with planning agencies within the study area and by the Mobile District, U.S. Army Corps of Engineers. In each case, the property inventories were compiled by 1980 census tract. The formats and level of detail for each county's inventory were the same in order to obtain maximum consistency in the results. The precise methods of inventory varied from county to county, depending upon the form and accessibility of property data.

Potential hurricane hazards - storm surge and winds data - were obtained from the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) mathematical model. The results of hurricanes modeled for the Tri-State Hurricane Evacuation Study were utilized to determine the critical storm track for each county by category of storm. The critical track is that track which would cause the greatest potential property damage. Based upon the potential still-water surge elevations above terrain, computations of wave heights were made to identify areas potentially vulnerable to wave activity.

The property loss zones developed for each county were delineated within the surge vulnerable areas of each county. Since wind damage from hurricanes potentially occurs for as much as 100 miles inland, it was determined that this study would

concentrate upon the more vulnerable areas of each study area county. Property loss zones were delineated principally in accordance with the 1980 census tracts for the area. In most instances, complete census tracts or combinations of tracts were utilized to compose the property loss zones. Final determinations of the numbers and areal extent of property loss zones for each county within the study area were made after exhaustive evaluations of several factors. These factors were:

- Resolution (number and size) of existing 1980 census tracts within a county or city.
- Extent of consistent terrain elevation.
- Areal extent of potential velocity zones.
- Consistency of stillwater surge elevations above terrain.
- Type and value of existing development.
- Existence and extent of political or other boundaries.
- Existence and extent of significant natural or man-made barriers affecting potential surge flooding or wave activity.

It was not necessarily the most developed counties that required the greatest number of loss zones in order to calculate potential hurricane damage. For example, Mobile County, Alabama is the most developed county within the study area; however, most of the development is located outside the area potentially threatened by storm surge flooding. In addition, the topography and development along the western shoreline of Mobile Bay is quite uniform which further reduces the required number of property loss zones. The numbers of loss zones developed for each county within the study area ranged from six in Baldwin County, Alabama and Hancock County, Mississippi to 41 in Jackson County, Mississippi. Mobile County, Alabama contained 19 while Harrison County, Mississippi contained 36.

DETERMINATION OF POTENTIAL PROPERTY LOSS

General Methodology. The major tasks included the input of property inventory and valuation data, average terrain and structure elevations, storm surge data, and windspeed data for each loss zone delineated for each county within the study area. The model used to calculate potential property damage for the Tri-State Property Loss and Contingency Planning Study was a spreadsheet model developed by the Mobile District. Generally, the model was designed as a series of individual spreadsheets for

each loss zone established within each county and contained all of the property, geographic, and storm data previously listed. A series of five spreadsheets was developed for each loss zone corresponding to the five categories of hurricane intensity. An example of damage calculations by hurricane category for an individual loss zone is shown in Tables VII through XI, starting on page 81 of the Technical Data Report.

Surge Data. The surge height data used in the model for each property loss zone was that derived from the SLOSH model. Surge height data from the simulated hurricanes modeled for the critical storm track for each county were entered into the model. The model used these data to calculate potential surge height above terrain and surge depth within structures by storm category.

Wind Data. Windspeed data from the SLOSH model were entered for each category of hurricane. For inland locations, the SLOSH model windspeeds were converted to surface windspeeds to account for the effects of vegetation and structures in reducing these speeds overland. Expected peak gusts windspeeds by storm category were used in the calculations of property damage.

Damage Curves. The damage curves for stillwater surge, velocity and winds were selected from property damage studies conducted within the State of Florida. These included the Tampa Bay Region Hurricane Loss and Contingency Planning Study, West Florida Region Hurricane Loss and Contingency Planning Study, South Florida Region Hurricane Loss and Contingency Planning Study, and the Apalachee Region Hurricane Loss and Contingency Planning Study.

GENERAL STUDY RESULTS

The results of the study indicate, based on the total structural damages calculated for each county, that in most instances, the greatest magnitude of damage, even in the surge vulnerable areas, is caused by winds rather than stillwater surge or wave action. In certain counties, this is true even for the more intense hurricanes. This is probably due to several factors. First, the study area has had a long history of frequent hurricane events. The development patterns within the study area has most probably been influenced by these events, especially the location of older structures. Apparent risk taking by developers has increased in recent years as newer structures, especially hotels and condominiums, have been constructed in significant concentrations in the more vulnerable coastal locations. However, the existence of and participation in the Federal Flood Insurance Program by the study area counties has helped to partially mitigate potential damages from surge flooding within these developments. The total property damages

for each county by hurricane category begins on page 86 of the Technical Data Report and continues through page 110.

The relative magnitude of damage between surge, velocity and wind changes as storm category changes. The relative magnitude of damages by county and category of hurricane is shown graphically starting on page 112 of the Technical Data Report. In some instances, the magnitude of surge damage from a Category 4 hurricane exceeds the damages caused by winds while, in the same county, the amount of wind damage from a Category 5 hurricane exceeds that from surge. While the surge heights from a Category 5 hurricane would be higher than from a Category 4 in a specific location near the storm center, the Category 5 hurricane, due to the smaller radius of maximum winds, would not necessarily cause the most overall surge damage within a county. This phenomenon is illustrated in the relative magnitude of damages shown graphically in the Technical Data Report.

STUDY RESULTS BY COUNTY

The following provides a brief discussion of the study results by county. These discussions primarily describe the potential impacts to residential, commercial/industrial and public facilities from hurricane occurrences. Other categories of damage and more detail can be found for each county within the Technical Data Report for the study.

Hancock County, Mississippi. The potential property damages from Category 1 and Category 2 hurricanes in Hancock County are expected to occur primarily from winds. Within the surge vulnerable areas, wind damage would account for an estimated \$18.0 million in damages to residential, \$890,000 to commercial/industrial development and \$730,000 to public facilities for a Category 2 hurricane. Damages from Category 3 and greater hurricanes increase dramatically from those of minor storms and the majority of potential damage shifts from wind generated to that caused by storm surge and wave action. Total potential damages to public facilities range from \$6.8 million for a Category 3 hurricane to \$26 million for a Category 5 storm. Over 90% of this potential damage would be surge and wave related. The corresponding ranges of potential damages for residential development are \$119.8 million to \$257.9 million. For commercial/industrial development, the range is \$20.8 million to \$69.9 million. As with public facilities, over 90% of these potential damages would occur due to storm surge flooding and wave action.

Harrison County, Mississippi. The potential property damages from Category 1 and Category 2 hurricanes in Harrison County are expected to occur primarily from winds. Within the surge vulnerable areas, total damages are estimated to be \$82.9

million for residential development, \$15.4 million to commercial/industrial development and \$7.1 million to public facilities for a Category 2 hurricane. Some surge damage would also occur from a Category 2, amounting to about 10% of residential and commercial/industrial development to 50% for public facilities. Damages from Category 3 and greater hurricanes increase substantially from those of the minor storms and the majority of potential damage shifts from wind generated to that caused by storm surge and wave action. Total potential damages to public facilities range from \$22.2 million for a Category 3 hurricane to \$116.2 million for a Category 5 storm. About 50% of this potential damage would be surge and wave related. The corresponding ranges of potential damages for residential development are \$192.5 million to \$599.9 million. For commercial/industrial development, the range is \$56.3 million to \$415.9 million. About 75% to 80% of these potential damages would occur due to storm surge flooding and wave action.

Jackson County, Mississippi. The potential property damages from Category 1 and Category 2 hurricanes in Jackson County are expected to occur primarily from winds. Within the surge vulnerable areas, total damages are estimated to be \$174.5 million for residential development, \$48.4 million to commercial/industrial development and \$5.7 million to public facilities for a Category 2 hurricane. Some surge damage would also occur from a Category 2, amounting to about 2% of residential, 5% of commercial/industrial and 25% of public facilities. Damages from Category 3 and greater hurricanes increase significantly from those of the minor storms and the majority of potential damage shifts from wind generated to that caused by storm surge and wave action. Total potential damages to public facilities range from \$6.7 million for a Category 3 hurricane to \$52.4 million for a Category 5 storm. About 60% to 75% of this potential damage would be surge and wave related. The corresponding ranges of potential damages for residential development are \$214.3 million to \$519.8 million. For commercial/industrial development, the range is \$837.8 million to \$2.1 billion. Over 90% of these potential damages would occur due to storm surge flooding and wave action.

Mobile County, Alabama. The potential property damages from Category 1 through Category 3 hurricanes in Mobile County are expected to occur primarily from winds. Within the surge vulnerable areas, total damages from wind could account for an estimated \$54.6 million in damages to residential, \$12.1 million to commercial/industrial development and \$8.8 million to public facilities for a Category 3 hurricane. Damages from Category 4 and greater hurricanes increase dramatically; however, the majority of potential damage remains primarily wind generated with some caused by storm surge flooding and wave action. Total potential damages to public facilities range from \$31.0 million

for a Category 4 hurricane to \$41.9 million for a Category 5 storm. About 75% of the potential damage to public facilities for a Category 4 hurricane would be surge and wave related while about 15% damage from surge flooding would occur for a Category 5 storm. The corresponding ranges of potential damages for residential development are \$148.0 million to \$152.0 million, primarily wind generated. For commercial/industrial development, the range is \$110.2 million for a Category 4 hurricane but drops to \$81.3 million for a Category 5, due to less wind damage. Potential surge damage accounts for about 80% of damages in a Category 4 hurricane and about 50% in a Category 5 storm.

Baldwin County, Alabama. The potential property damages from Category 1 and Category 2 hurricanes in Baldwin County are expected to occur primarily from winds. Within the surge vulnerable areas, total damages from wind could result in an estimated \$19.3 million in damages to residential, \$1.0 million to commercial/industrial development and \$2.3 million to public facilities for a Category 2 hurricane. Damages from Category 3 and greater hurricanes increase significantly; however, the majority of potential damage shifts from wind generated to that caused by storm surge and wave action. Total potential damages to public facilities range from \$7.4 million for a Category 3 hurricane to \$15.3 million for a Category 5 storm. About 50% of the potential damage to public facilities would be surge and wave related. The corresponding ranges of potential damages for residential development are \$49.9 million to \$136.9 million. From 50% to 75 of these potential damages are expected to be caused from surge flooding and wave action. For commercial/industrial development, the range is \$5.8 million to \$18.7 million. From 60% to 80% of these damages would be caused by storm surge flooding and wave action.

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